

WHAT IS CLAIMED IS

1. A method of checking overlap accuracy of patterns on four stacked semiconductor layers, comprising:
  - forming a first checking pattern on a first semiconductor layer, a second checking pattern on a second semiconductor layer, a third checking pattern on a third semiconductor layer and a fourth checking pattern on a fourth semiconductor layer, wherein the first, second and third checking patterns overlap to form a first rectangular frame, the fourth checking pattern is surrounded by the first rectangular frame, a first pair of parallel sides of the first rectangular frame is formed by the first checking pattern, and a second pair of parallel sides of the first rectangular frame is formed by the second and third checking patterns;
  - measuring overlap accuracy between the fourth checking pattern and the first checking pattern; and
  - measuring overlap accuracy between the fourth checking pattern and the second and third checking patterns.
2. The method as claimed in claim 1, wherein the second checking pattern comprises a pair of second parallel line-shaped patterns inside the second pair of parallel sides of the first rectangular frame respectively.
3. The method as claimed in claim 2, wherein the third checking pattern comprises a pair of third parallel line-shaped patterns outside the second pair of parallel sides of the first rectangular frame respectively.
4. The method as claimed in claim 1, wherein the fourth checking pattern comprises a fourth line-shaped pattern to form a second rectangular frame.
5. The method as claimed in claim 1, wherein the first checking pattern comprises two pairs of first line-shaped patterns on the first pair of parallel sides of the first

4 rectangular frame respectively and the two pairs of first  
5 line-shaped patterns are parallel.

1 6. The method as claimed in claim 1, wherein the first  
2 checking pattern comprises a pair of first parallel line-  
3 shaped patterns on the first pair of parallel sides of the  
4 first rectangular frame respectively.

1 7. The method as claimed in claim 1, further comprising:  
2 measuring the first checking pattern to obtain a first  
3 position in a first dimension;  
4 measuring the fourth checking pattern to obtain a second  
5 position in the first dimension; and  
6 checking if the first and second positions fall within a  
7 predetermined error range.

1 8. The method as claimed in claim 3, further comprising:  
2 measuring the second and third line-shaped patterns on  
3 one side of the second pair of parallel sides of the first  
4 rectangular frame to obtain a first average position;  
5 measuring the second and third line-shaped patterns on  
6 the other side of the second pair of parallel sides of the  
7 first rectangular frame to obtain a second average position;  
8 averaging the first average position and the second  
9 average position to obtain a third position;  
10 overlap scanning the fourth checking pattern on the  
11 fourth semiconductor layer to obtain a fourth position of the  
12 fourth checking pattern along the direction parallel to the  
13 first pair of parallel sides; and  
14 checking if the third and fourth positions fall within a  
15 predetermined error range.

1 9. The method as claimed in claim 1, wherein the second  
2 checking pattern comprises a second line-shaped pattern on  
3 one side of the second pair of parallel sides of the first  
4 rectangular frame and the third checking pattern comprises a

5 third line-shaped pattern on the other side of the second  
6 pair of parallel sides of the first rectangular frame.

1 10. The method as claimed in claim 9, further comprising:  
2 measuring the second line-shaped pattern on one side of  
3 the second pair of parallel sides of the first rectangular  
4 frame to obtain a first position X'01 of the second line-  
5 shaped pattern;

6 measuring the third line-shaped pattern on the other side  
7 of the second pair of parallel sides of the first rectangular  
8 frame to obtain a second position X'02 of the third line-  
9 shaped pattern;

10 averaging the first position X'01 of the second line-  
11 shaped pattern and the second position X'02 of the third  
12 line-shaped pattern to obtain a third position representing  
13 the average location of the second and third checking  
14 patterns;

15 overlap scanning the fourth checking pattern along the  
16 direction parallel to the first pair of parallel sides of the  
17 first rectangular frame to obtain a fourth position; and

18 checking if the third and fourth positions fall within a  
19 predetermined error range.

1 11. A method of checking overlap accuracy of patterns on  
2 four stacked semiconductor layers, comprising:

3 forming a first checking pattern on a first semiconductor  
4 layer, a second checking pattern on a second semiconductor  
5 layer, a third checking pattern on a third semiconductor  
6 layer and a fourth checking pattern on a fourth semiconductor  
7 layer, wherein the first, second and third checking patterns  
8 overlap to form a first rectangular frame, a first pair of  
9 parallel sides of the first rectangular frame is formed by  
10 the first checking pattern, a second pair of parallel sides  
11 of the first rectangular frame is formed by the second and

12 third checking patterns, and the fourth checking pattern is  
13 arrayed as a second rectangular frame and is surrounded by  
14 the first rectangular frame;

15 measuring overlap accuracy between the fourth checking  
16 pattern and the first checking pattern; and

17 measuring overlap accuracy between the fourth checking  
18 pattern and the second and third checking patterns.

1 12. The method as claimed in claim 11, wherein the second  
2 checking pattern comprises a pair of second parallel line-  
3 shaped patterns inside the second pair of parallel sides of  
4 the first rectangular frame respectively.

1 13. The method as claimed in claim 12, wherein the third  
2 checking pattern comprises a pair of third parallel line-  
3 shaped patterns outside the second pair of parallel sides of  
4 the first rectangular frame respectively.

1 14. The method as claimed in claim 11, wherein the second  
2 checking pattern comprises a second line-shaped pattern on  
3 one side of the second pair of parallel sides of the first  
4 rectangular frame, and the third checking pattern comprises a  
5 third line-shaped pattern on the other side of the second  
6 pair of parallel sides of the first rectangular frame.

1 15. The method as claimed in claim 11, wherein the first  
2 checking pattern comprises two pairs of first line-shaped  
3 patterns on the first pair of parallel sides of the first  
4 rectangular frame respectively and the two pairs of first  
5 line-shaped patterns are parallel.

1 16. The method as claimed in claim 11, wherein the first  
2 checking pattern comprises a pair of first parallel line-  
3 shaped patterns on the first pair of parallel sides of the  
4 first rectangular frame respectively.

1 17. The method as claimed in claim 11, further  
2 comprising:

3 measuring the first checking pattern to obtain a first  
4 position in a first dimension;  
5 measuring the fourth checking pattern to obtain a second  
6 position in the first dimension; and  
7 checking if the first and second positions fall within a  
8 predetermined error range.

1 18. The method as claimed in claim 13, further  
2 comprising:

3 measuring the second and third line-shaped patterns on  
4 one side of the second pair of parallel sides of the first  
5 rectangular frame to obtain a first average position;

6 measuring the second and third line-shaped patterns on  
7 the other side of the second pair of parallel sides of the  
8 first rectangular frame to obtain a second average position;

9 averaging the first average position and the second  
10 average position to obtain a third position;

11 overlap scanning the fourth checking pattern on the  
12 fourth semiconductor layer to obtain a fourth position of the  
13 fourth checking pattern along the direction parallel to the  
14 first pair of parallel sides; and

15 checking if the third and fourth positions fall within a  
16 predetermined error range.

1 19. The method as claimed in claim 14, further  
2 comprising:

3 measuring the second line-shaped pattern on one side of  
4 the second pair of parallel sides of the first rectangular  
5 frame to obtain a first position X'01 of the second line-  
6 shaped pattern;

7 measuring the third line-shaped pattern on the other side  
8 of the second pair of parallel sides of the first rectangular  
9 frame to obtain a second position X'02 of the third line-  
10 shaped pattern;

11            averaging the first position X'01 of the second line-  
12    shaped pattern and the second position X'02 of the third  
13    line-shaped pattern to obtain a third position representing  
14    the average location of the second and third checking  
15    patterns;  
16            overlap scanning the fourth checking pattern along the  
17    direction parallel to the first pair of parallel sides of the  
18    first rectangular frame to obtain a fourth position; and  
19            checking if the third and fourth positions fall within a  
20    predetermined error range.

20220722 09:22:00